Energy Storage: Let's keep it simple

Utah Energy Summit—February 15, 2012

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ROCKY MOUNTAIN POWER

Let's turn the answers on.

1912–2012 100 Years

What We'll Cover Today

- Who is Rocky Mountain Power?
- Utility Energy Storage Basics
- Rocky Mountain Power's experience with energy storage
- Rocky Mountain Power's plans for energy storage in the future

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A Century of Service

For 100 years, customers in Utah, Idaho and Wyoming have “flipped a switch” and Rocky Mountain Power has powered their lives with safe and dependable electric service.

A Century of Service

- Salt Lake City was the fifth city in the world to have central station electricity behind only London, New York City, San Francisco and Cleveland.
- The Company was formed in 1912 with 39,700 customers
- Now, RMP serves over 1 million customers
  - 837,000 in Utah
  - 144,000 in Wyoming
  - 75,000 in Idaho

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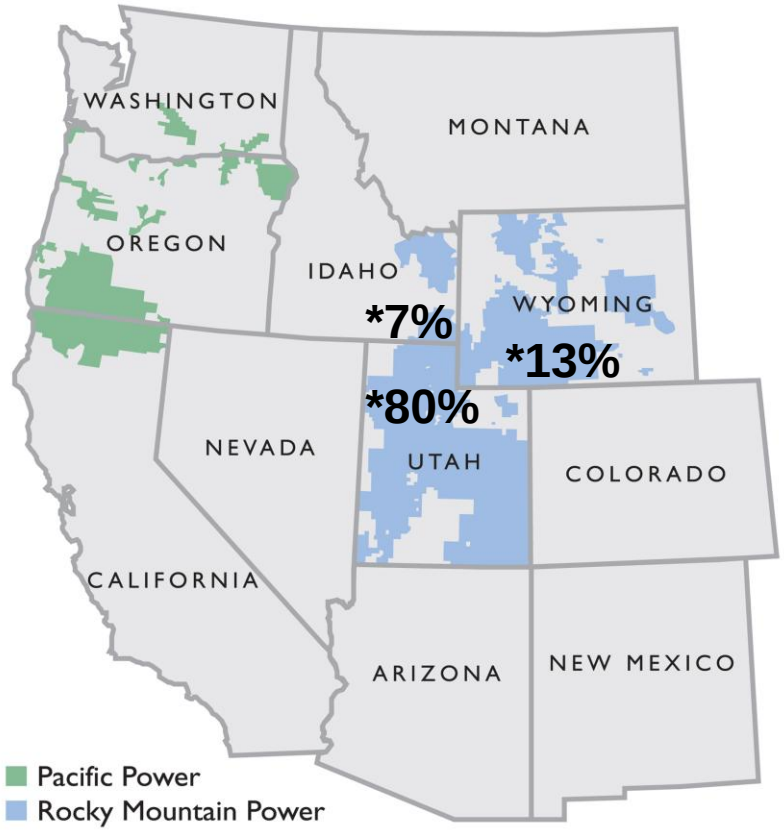
About PacifiCorp

- PacifiCorp Customers 1.8 million
- Employees 6,447
- Territory 136,000 sq. mi.
- Distribution
  - ✓ 817 Substations
  - ✓ 62,000 Line Miles
- Transmission
  - ✓ 262 Substations
  - ✓ 15,900 Line Miles
- Generation
  - ✓ 78 Plants
  - ✓ 10,483 MW Capacity
    - ➢ 3,100 MW Renewable



*shows % of RMP customers by state

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Core Principles

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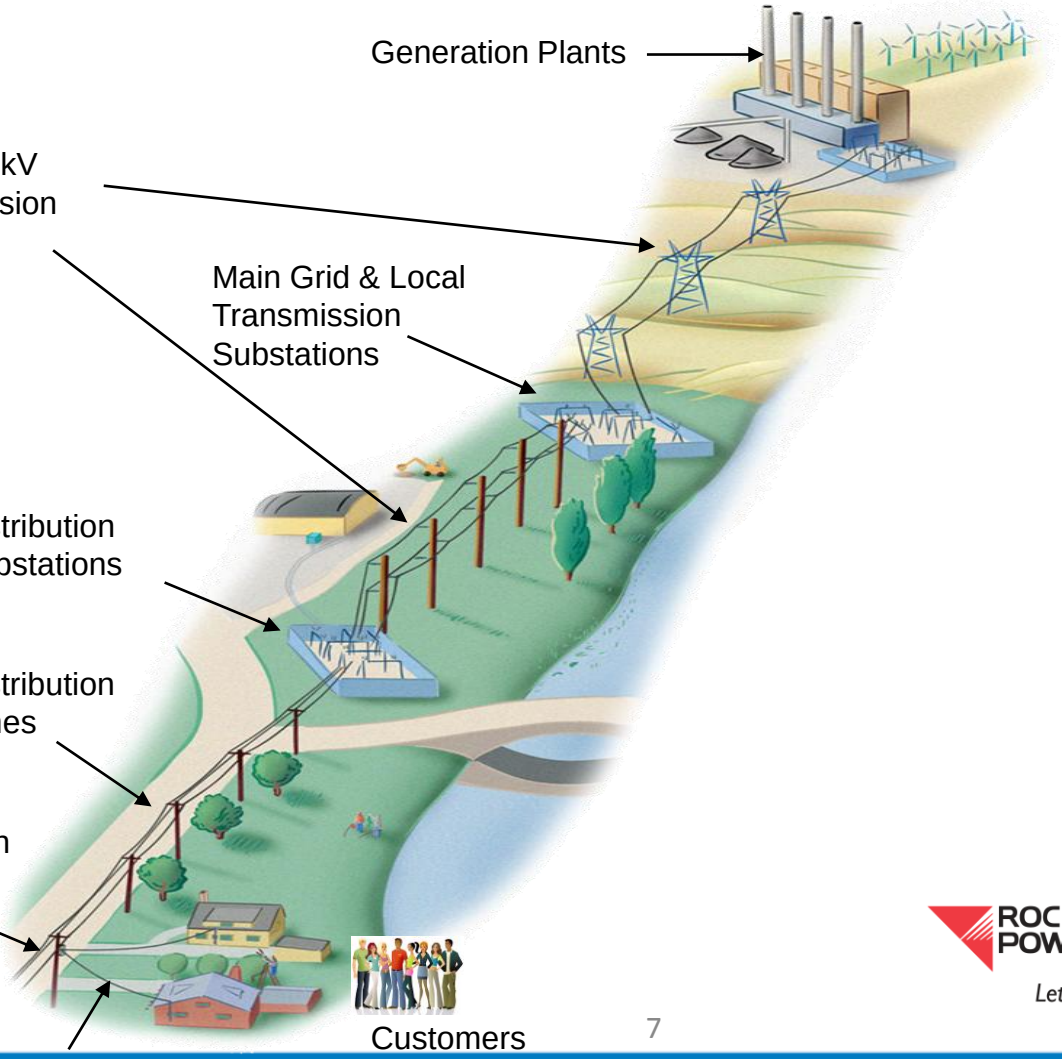
The Power System of Yesteryear



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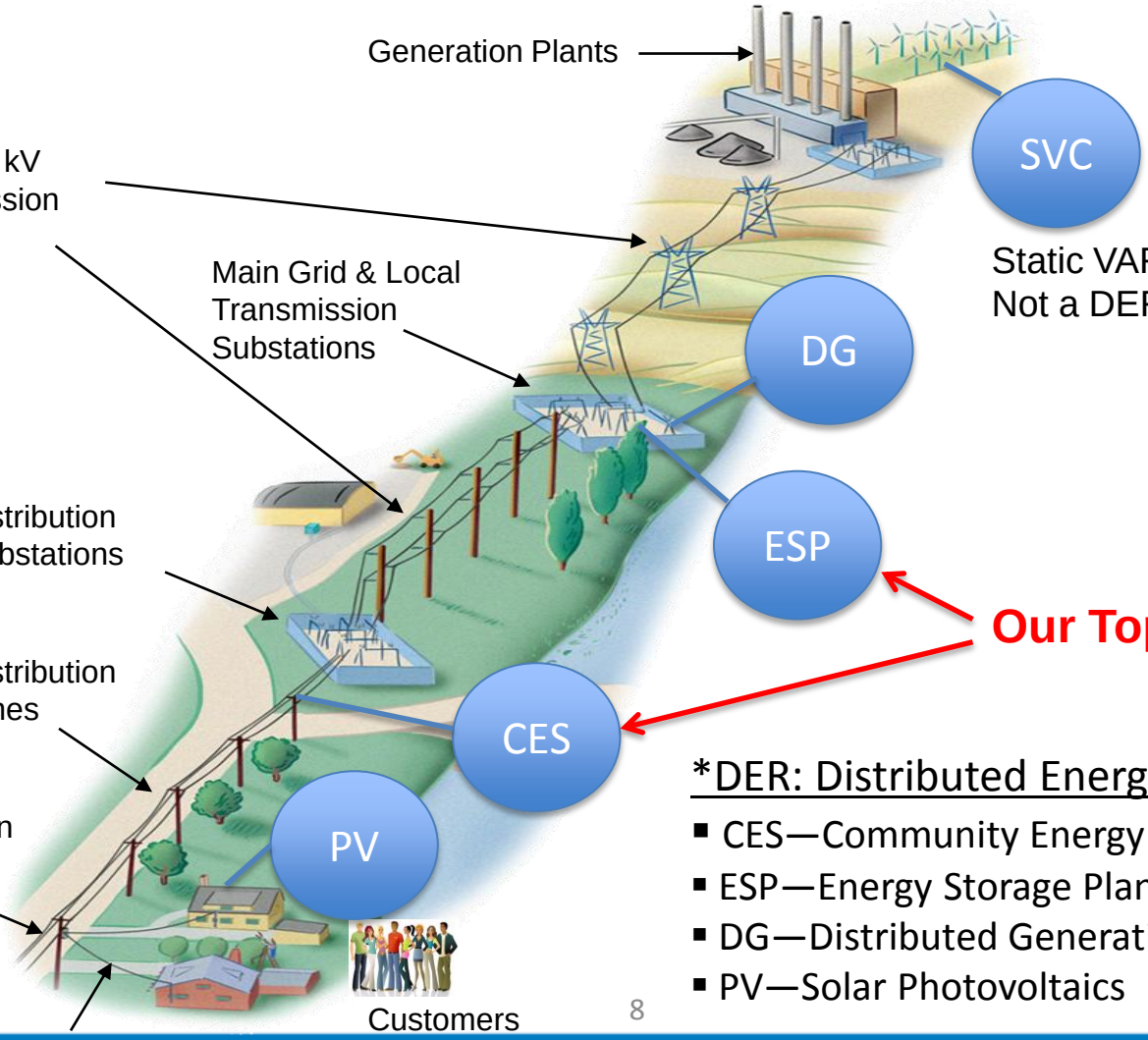
The Power System of the Future with DER*



Static VAR Compensator:
Not a DER, but somewhat new.

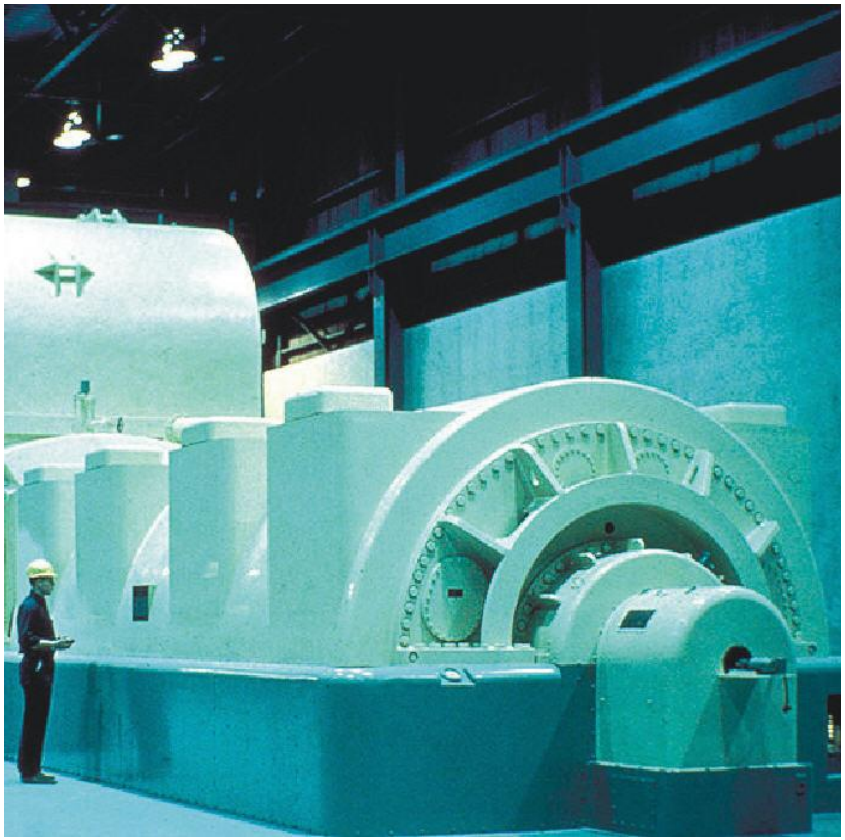
Our Topic Today

*DER: Distributed Energy Resources

- CES—Community Energy Storage
- ESP—Energy Storage Plant
- DG—Distributed Generation
- PV—Solar Photovoltaics

Now Some Utility Storage Basics

- Electric utilities are unique —historically we have not “warehoused” electricity AFTER its production—it’s been too costly.
- Traditional hydroelectric and fossil generation needs are forecast & matched to load minute by minute.
- Historically the storage has been in two places:
  - the collective “rotating mass” of the interconnected power system
  - The hydro reservoirs and coal piles of the power plants
- Wind and solar are different…



Most Large-scale Renewables Could Benefit from Storage

- PacifiCorp has the 2nd largest amount of connected wind energy capacity in the country.
- But the wind doesn't always blow and is not dispatchable.
- Cost-effective energy storage would help.

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Potential Utility Storage "Apps"

(from 19 possible applications in the Sandia Labs Report, Feb 2010)

- **Large-scale Energy**
  - Energy time shift (without renewables)
  - Renewables integration (long-term)
  - Demand response
  - Supply reserve
  - Investment deferral
  - Transmission congestion relief
- **Smaller-scale Energy**
  - Frequency regulation (Energy balancing)
  - Steady-state V support
  - Renewables integration (short-term)
  - Sag ride-through
  - Outage ride-through

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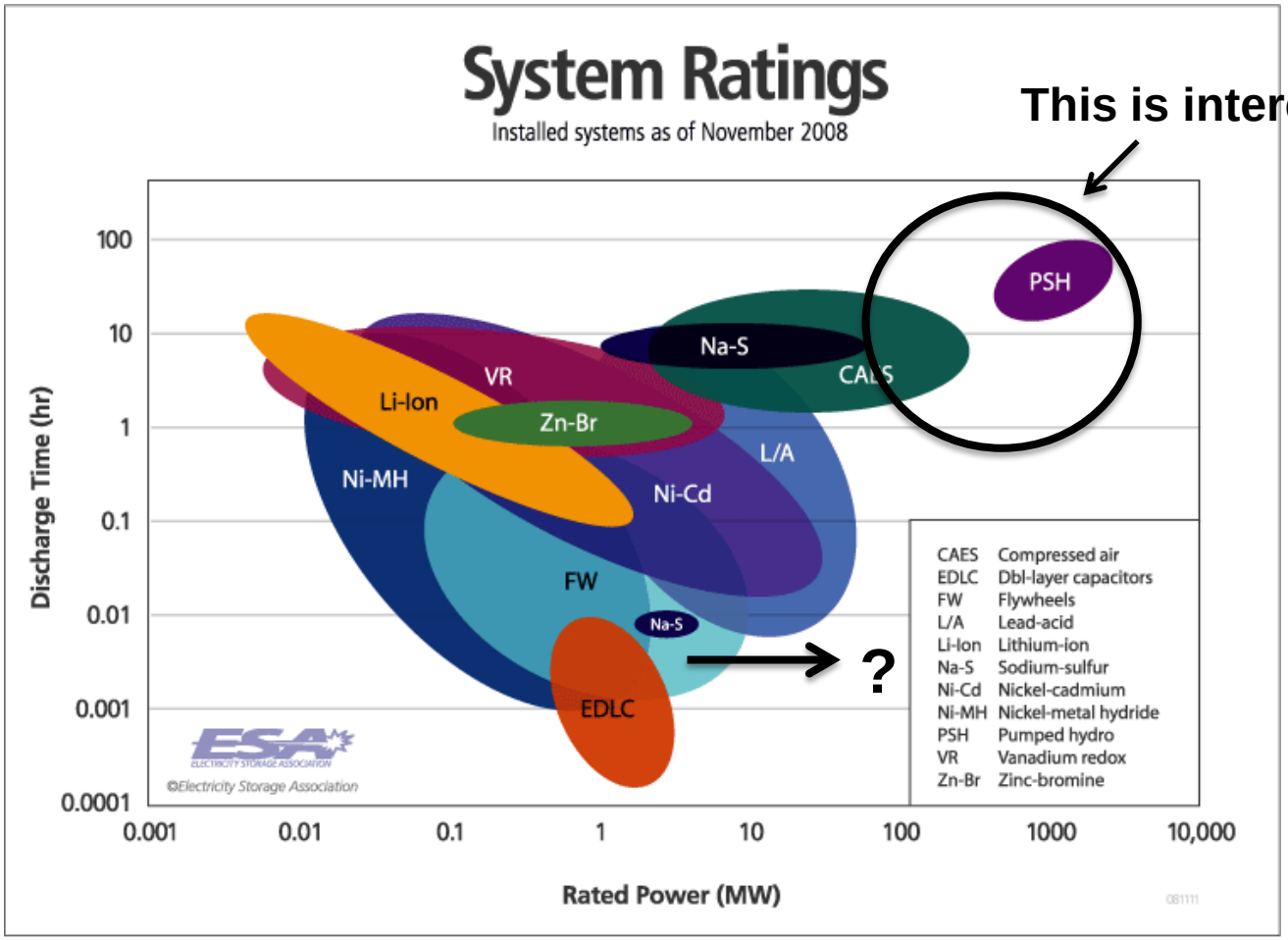
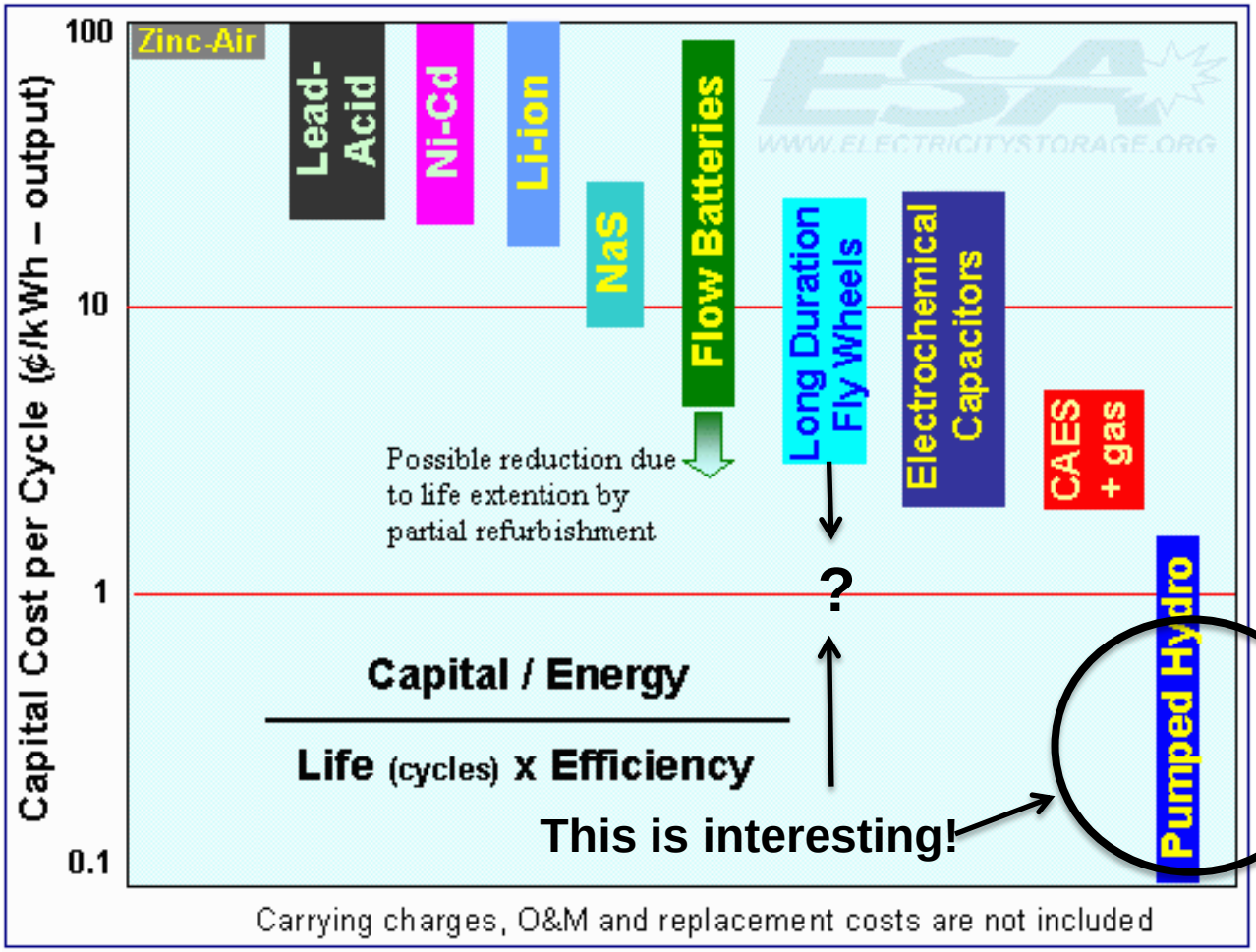
Electricity Storage Options

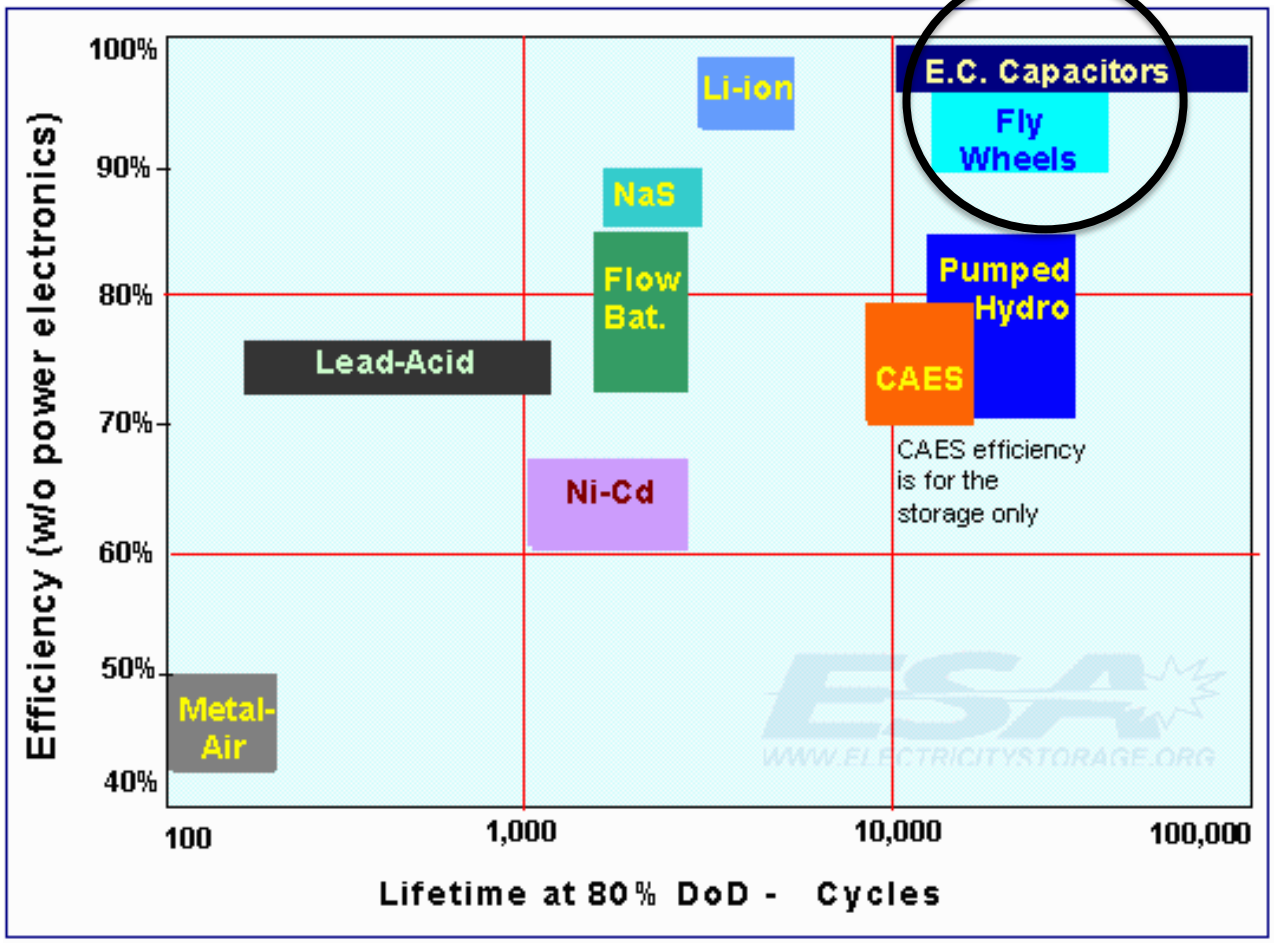


Per cycle storage costs



Life cycle Efficiencies

This is interesting!



PacifiCorp Already Has Some Energy Storage

- Our own hydro fleet is utilized
- Most hydro is run-of-river (little storage)
- Limited “paper pond” hydro contracts with other entities
- We have some storage-integration agreements with owners of wind turbines
- Most proposals offer little control to give us energy quickly when we need it.
- Proposals must “pencil out” for “win-win” agreement

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RMP's First Experience with Non-traditional Storage Technology

Castle Valley Vanadium Redox Battery (VRB)

- Energy time shift
- Near Moab, Utah
- End of very long 25 kV distribution feeder
- Load was growing
- Couldn't build new assets—national parks
- "Early adopter" troubles
- Environmental concerns

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Will Demonstrate New Technology…
IF EMB is Successfully Developed

“Electromechanical Battery” – EMB

- Inventor—Dr. Richard Post of LLNL
- Three enabling technologies
  - Hi-tech flywheel spinning in vacuum
  - Passive magnetic bearings
  - Electrostatic motor/generator
- EMB Energy is private developer
- Regulators fully aware
- Demo of 25 MW / 25 MWh plant
- Location at Lampo sub in N. Utah IF EMB is successfully tested

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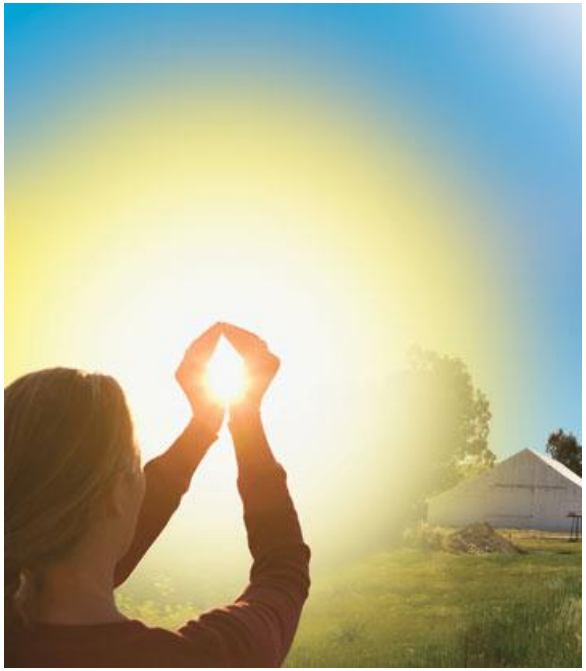
Planning for the Future



We embrace energy storage if and where…

- It helps us provide safe and reliable power to our customers
- It meets balanced outcomes
  - The price is right
  - A new fully-developed technology serves us better than existing technologies
  - It has minimal impact on the environment
  - We have regulatory approval

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